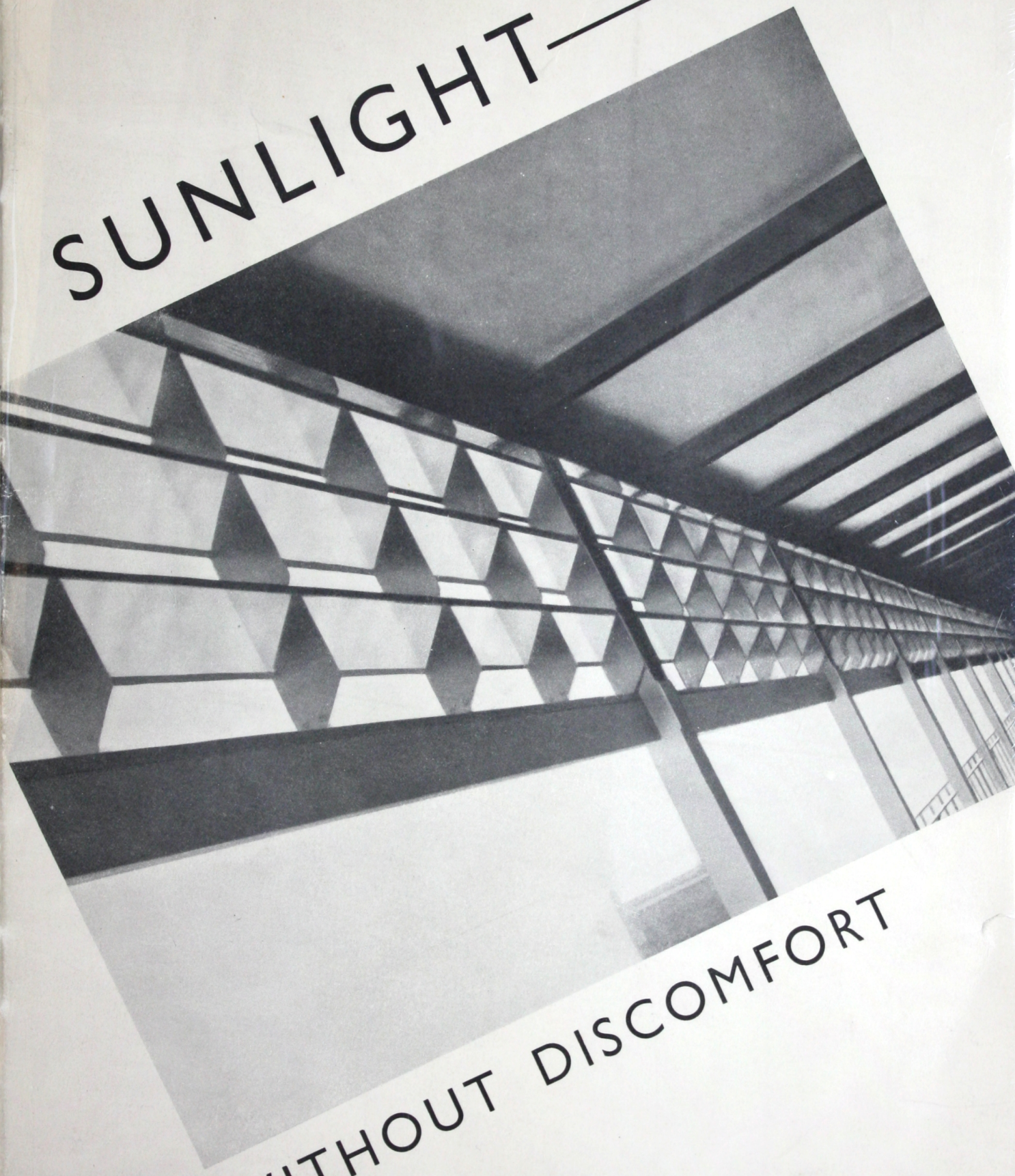
SUNLIGHT



WITHOUT DISCOMFORT

SUNLIGHT WITHOUT DISCOMFORT

being some account of the properties and values of heat-excluding, light-transmitting "CALOREX" GLASS

"CALOREX"
is the Regd. Trade Mark of
Chance Brothers and Co., Limited.

CHANCE BROTHERS and Co. LIMITED
MANUFACTURERS OF GLASS
BIRMINGHAM GLASGOW
LONDON OFFICE: Clutha House, Princes Street, S.W.1

HONG KONG & SHANGHAI BANKING CORPORATION
SINGAPORE

FOREWORD

At the time when this Company was developing "Crookes" glass, it became clear that glass having special absorptive properties (such as this material possessed) would be of definite value in a far wider field than in optics alone. Experiments were therefore carried out and certain "anti-fade" glasses were evolved, and supplied, to meet special requirements.

Then came the War, and, with it, an urgent demand for a "non-actinic" (or, to be more accurate, "anti-actinic") glass to protect airships. Investigations were carried out by Chance's on the deterioration of doped fabric under sunlight, and on the protection afforded by various types of glass. The ability to exclude heat was found to be an important factor and special study was given to the production of this quality. The result was a new form of rolled glass (called "3A. Anti-fade") which, in addition to its anti-actinic properties, had in effect some capacity for the selective absorption of heat, and was adopted for use by the Admiralty, from whom Chance's received letters of thanks for the work carried out in its development.

Further experiments, however, culminated in the highly specialised "Calorex" which is regarded by experts as one of the most interesting introductions of recent years into the world of glass, and to the building industry.

TYPES & SIZES

IN WHICH "CALOREX" IS MADE

Rough Cast... ...	$\frac{1}{8} \times 96 \times 40$	$\frac{1}{4} \times \begin{cases} 80 \times 36 \\ 108 \times 24 \end{cases}$	inches
Glistre	$\frac{1}{8} \times 96 \times 40$		inches
Ground and Polished		$\frac{1}{4} \times 60 \times 36$	inches
Clear Sheet... ...	$\begin{cases} 21 \text{ ozs.} : 45 \times 30 \text{ to } 36 \\ 32 \text{ ozs.} : 40 \times 32 \end{cases}$		inches

LIGHT TRANSMISSION AND HEAT EXCLUSION

The colour of "Calorex" itself is approximately indicated by that of the titles of the pages in this booklet, but the light which it gives is considerably whiter.

While the eye can roughly judge the amount of light which will be admitted by a glass it cannot guide one as to the power of that glass to keep a room cool in sunshine ; this property, curiously enough, does not depend upon depth of colour. This will be noticed on reference to the figures given in the table on page seven, and to the photographs on page nine where it will be seen that an amber glass which only admits about one quarter of the light, will let in nearly half the heat, of the sun.

If these figures, and others given in the table, be compared with those for "Calorex" the high value of this glass for heat absorption will be appreciated. It may be added that for all ordinary purposes it may be regarded as equal to its prototype, 3A. Anti-actinic, for its power to exclude ultra-violet rays.

CALOREX

(Patent No. 197500/1923)

Most people prefer to live in daylight. It is cheaper than artificial light, and healthier and pleasanter. Not everyone can avail himself of these advantages, however, because with the daylight comes the heat, and often the heat must be excluded at all costs. In the tropics, ironically enough, where the daylight is particularly hot and objectionable, artificial light is correspondingly expensive.

In "Calorex" are combined the seemingly irreconcilable qualities of admitting light and excluding heat.

Everyone must be familiar with the high temperature which prevails inside a glass-roofed building on a sunny day, even in the English climate—a temperature which leads to the perennial white-washing of the skylights in the summer and cleaning of them again in the autumn. We offer, in "Calorex," a solution to this problem and a removal of the inconvenience.

"Calorex" is a glass which intercepts more than 75% of the sun's heat while transmitting about 60% of its light. This glass has its own peculiar bluish tinge, which suggests its property of coolness. One notices, on entering a room glazed with "Calorex," the subdued restful tone of the light. After the impression of the first moment, however, all sense of colour disappears and (so far as one can be aware of any change from ordinary glass) one can detect only the restful, mellow character of the light.

The sphere of usefulness for "Calorex" includes examples of almost every kind of industrial and commercial activity; it is particularly to be desired in such buildings as factories and garages where extremes of temperature are undesirable or objectionable, and in warehouses for the storage of perishable or inflammable goods, as well as for hospitals, and offices where it is desirable to protect the staff from heat and eye-strain due to glare. It is also being largely used for glazing summer-houses, verandahs, fives and racquets courts and other buildings of this kind.

REPORT:

by the ASSISTANT ASTRONOMER of COLOMBO OBSERVATORY on some TESTS of Heat-Absorption by glass.

A sample of "Calorex" glass, 0.28 inch thick, and a piece of Rolled Skylight glass, 0.26 inch thick, were, at the request of Messrs. Walker & Co., tested for heat absorption at the Colombo Observatory. After a number of preliminary experiments, to determine the most suitable method with the instruments available, the test was carried out as follows:—

The roofs of three thermometer screens were removed; for one roof, the plate of "Calorex" was substituted; for another, the plate of rolled glass; while the third screen was left roofless. Solar radiation thermometers were exposed in each screen, the bulbs being at first sheltered from direct radiation from the sun, but not from surrounding bodies. The initial temperature under these conditions, and the final temperature when the sun was allowed to shine directly on the bulbs, will, from Stefan's formula, enable the percentage amount of absorption in the glass to be calculated.

As, however, solar radiation thermometers, even when apparently exactly alike, differ considerably from each other, owing mainly to differences in the degree of vacuum surrounding the black bulbs, the experiments were carried out in triplicate, the thermometers being interchanged after each experiment. In this way, although the individual results may differ considerably from each other, the mean should be fairly near the true value.

As a check upon the results calculated according to Stefan's formula, the rate at which each thermometer commenced to rise when the sun's rays began to shine directly on it, was noted. These rates should be proportional to the heat received by the thermometers, and the figures obtained in this way afforded a satisfactory check on those obtained by the other method.

The results may be summed up as follows:—

The "Calorex" sample allowed 24% of the heat radiation to pass, absorbing 76%. The Rolled Skylight sample allowed 68% of the heat radiation to pass, absorbing 32%.

¶ A copy of the original full text of this Report, together with the thermometer readings, will be sent to anyone who is interested.

TABLE

showing the relative
light and heat transmission properties
of various rolled plate glasses

NAME OF GLASS	Sun's Heat Transmitted	Daylight Transmitted
Ordinary Rolled Plate ...	70%	86%
Amber Rolled Plate ...	46%	26%
3A Anti-Actinic	41%	67%
"Calorex"	20%	61%

CHART

showing at a glance
the protection which "Calorex" affords
against heat and glare.

PROOF by PHOTOGRAPHY

PHOTOGRAPHS OF THE VISIBLE AND INFRA-RED BEAMS TRANSMITTED BY "CALOREX," EXTRA WHITE SHEET, ORDINARY SHEET AND SIGNAL ORANGE GLASSES.

One pane each of "Calorex," Extra White Sheet, Ordinary Sheet and Yellow, all 21-ozs., were taken from stock.

The apparatus used for the illumination was a $8\frac{3}{8}$-in. Step Lens with a Pointolite source. A uniform beam was thrown along a sheet of flashed opal.

Photographs were taken with each glass intercepting half the beam. The visible radiation was photographed on anti-screen backed plates, giving an exposure of 2 minutes at f/4-5. The infra-red radiation was photographed on Ilford I.R. plates using an Ilford I.R. filter, exposing for 8 minutes at f/4-5.

The source and lens were screened from the camera and the whole room was kept in complete darkness in order to render the photographs as exactly comparable as possible.

1 **"CALOREX"** shows slight visible absorption and complete infra-red absorption.

2 **EXTRA WHITE** shows negligible absorption of either wave band.

3 **ORDINARY SHEET** shows negligible visible absorption and very slight infra-red absorption.

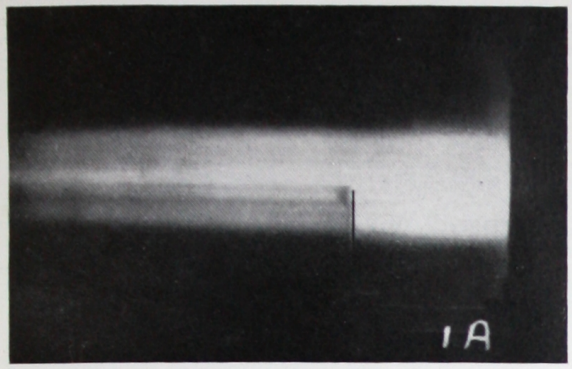
4 **SIGNAL ORANGE** shows considerable visible absorption and negligible infra-red absorption.

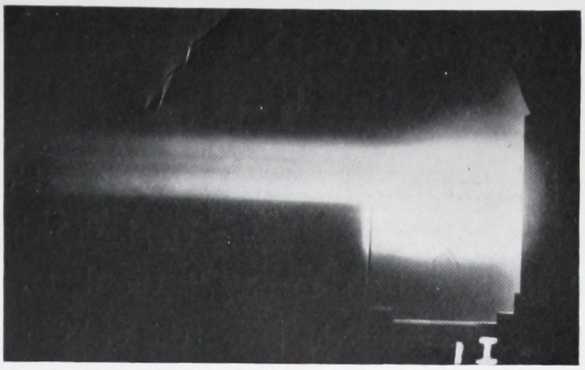
On the Left:

LIGHT TRANSMISSION

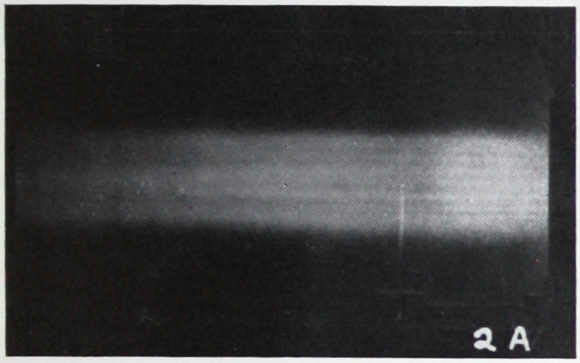
On the Right:

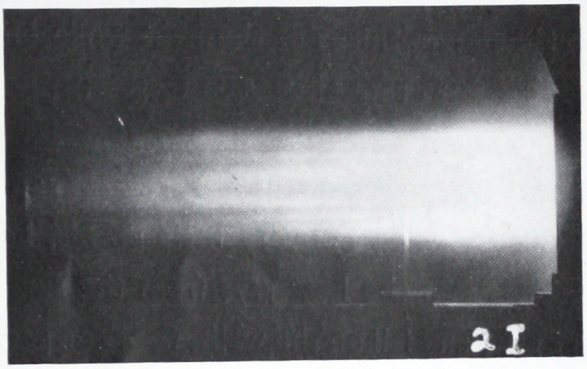
HEAT TRANSMISSION



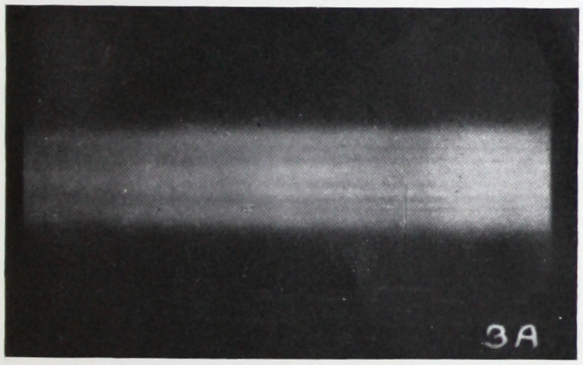


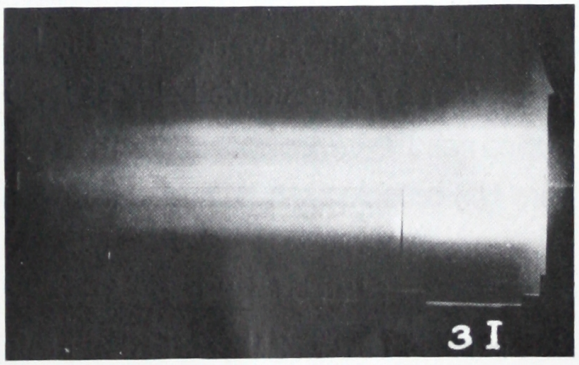
1. Calorex Sheet



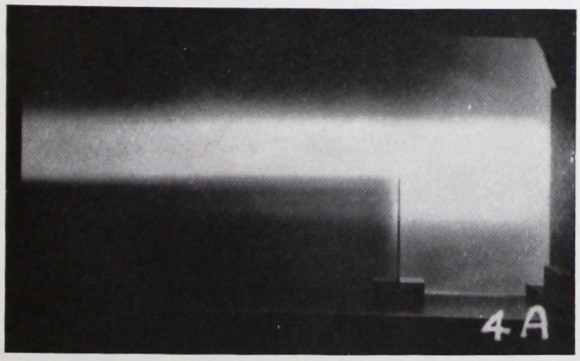


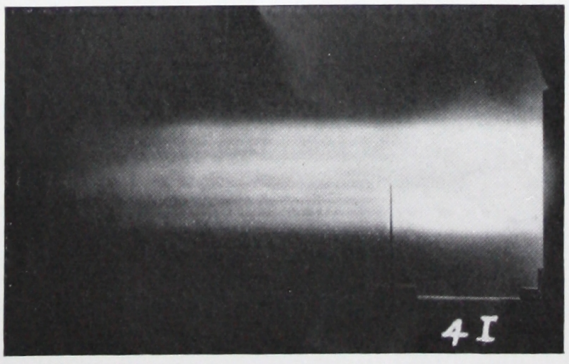
2. Extra-White Sheet





3. Ordinary Sheet





4. Signal Orange Sheet

HOW DOES IT WORK?

THE ACTION OF "CALOREX" EXPOSED TO THE SUN'S RAYS

The question is sometimes asked, "How does 'Calorex' 'exclude' the heat?" To answer this it is necessary to emphasise the difference between "excluding" and "absorbing," the latter being the expression preferred in stating the properties of "Calorex."

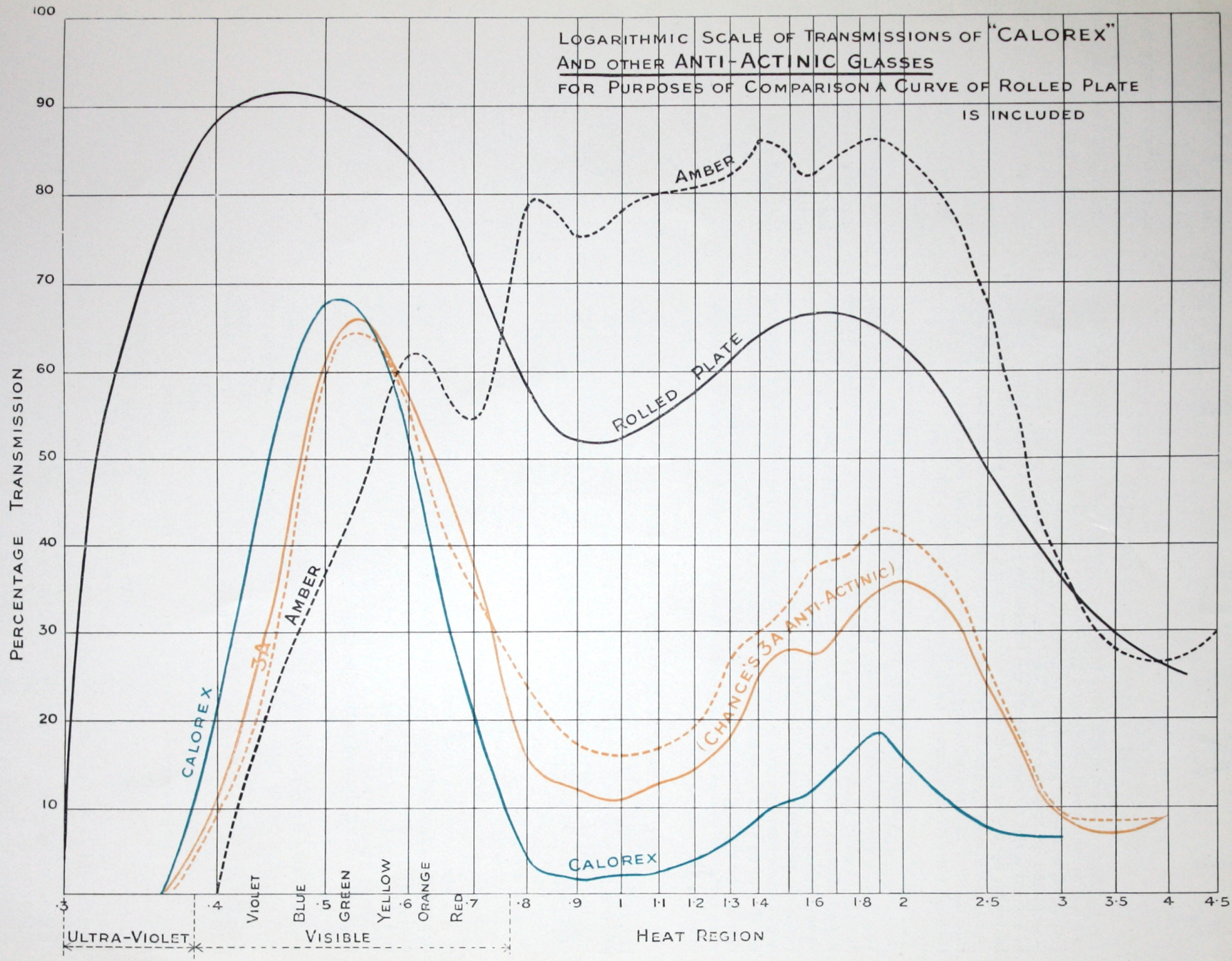
Its efficacy depends upon several factors, the first being its capability of passing about two-thirds of the light while only allowing about one-fifth of the heat rays of the sun to pass.

Those rays which are trapped cause the glass to warm up and in turn to radiate, but this radiation has very little power, being of long wave-length, and whereas the heat rays from the sun would pass through ordinary glass and fall on the walls, floors or persons within a building, the heat given off by the warmed "Calorex" window has an almost negligible power of penetration. The air against the window on both sides is, of course, warmed by the heat from the "Calorex" and rises, that on the outside being affected by wind as well as by convection; and it will be seen that there is thus more heat removed from the outside than is given off inwards.

To get the full advantages of "Calorex" it is necessary to see that adequate provision is made for natural ventilation preferably above and below the window: for skylights a jack-roof or louvres usually suffices, as the supply of air is drawn from the space below.

It is by this secondary action that the heat absorbed by "Calorex" is "excluded."

Fundamentally the action of the "Calorex" is that of transforming the heat waves of the sun, which are of relatively short length, into waves of much greater length and negligible penetrating power.


LOGARITHMIC SCALE OF TRANSMISSIONS OF "CALOREX" AND OTHER ANTI-ACTINIC GLASSES FOR PURPOSES OF COMPARISON A CURVE OF ROLLED PLATE IS INCLUDED
PERCENTAGE TRANSMISSION
100
90
80
70
60
50
40
30
20
10
AMBER
ROLLED PLATE
CALOREX
3A
AMBER
(CHANCE'S 3A ANTI-ACTINIC)
CALOREX
VIOLET
BLUE
GREEN
YELLOW
ORANGE
RED
·3
·4
·5
·6
·7
·8
·9
1
1·1
1·2
1·3
1·4
1·6
1·8
2
2·5
3
3·5
4
4·5
ULTRA-VIOLET
VISIBLE
HEAT REGION

A DETERRENT

The following are the result of experiments relating to the effect of "Calorex" glass on insects, which were carried out on behalf of Messrs. Chance Brothers and Co., Ltd., in the Entomology Department of the Imperial College of Science and Technology under the supervision of Professor J. W. Munro.

The object of the experiment was to ascertain whether the use of "Calorex" glass in buildings was deterrent to flies and other insects.

METHODS OF EXPERIMENT

The methods of experiment were first to enclose a number of insects in a cage, one half of which was illuminated by "Calorex" and the other half by ordinary glass, and second, to place baits of fermenting raisins or of meat in an open cage illuminated on the one half by "Calorex" and on the other by ordinary glass. In a third series of experiments the insects were imprisoned in a glass cylinder to which light was permitted to enter through ordinary glass and "Calorex" glass. The movements of the insects in the cylinder were easily observable, and this method had the advantage that the insects could be subjected to light through the different glasses without having to be handled.

INSECTS USED IN THE EXPERIMENTS

The insects experimented with were the House Fly (*Musca domestica*), Vinegar flies (*Drosophila* species), the Honey Bee (*Apis mellifica*), the common Wasp (*Vespa vulgaris*), and various insects affecting stored grain, namely, the Grain Weevils (*Sitophila granaria*), the Grain Moth (*Sitotroga cerealella*), the Meal Worm (*Tenebrio molitor*), and the Flour Moth (*Ephestia kuhniella*).
It was found that bees, wasps and flies reacted more than any of the other insects, which was to be expected. The Grain Weevils and the Grain and Flour Moths reacted so slightly that no conclusion could be drawn except that they moved away from the source of light whether it came through "Calorex" or through ordinary glass.

EXPERIMENTS WITH THE HOUSE FLY

House flies exposed to sunlight in a box, one half illuminated with "Calorex" and one half with ordinary glass, showed a marked preference for the half of the box illuminated by ordinary glass. The following figures indicate the average difference in numbers under the two types of glass in various experiments:—

"Calorex"	*Ordinary*	*"Calorex"*	*Ordinary*
6	19	4	10
8	16	5	9
4	10	5	9

It was observed that apart from the light factor the temperature factor was important and, accordingly, experiments were carried out in which fermenting raisins were exposed in a chamber open at the rear but enclosed on top, bottom and sides, and having a sloping front one half of which was closed by a sheet of "Calorex" glass and the other a sheet of plain glass. These panes of glass fitted in grooves which allowed of their being interchanged.

The following figures show the variation in temperature recorded in the two halves of the chamber during the day, and are typical of the variation in sunny weather.

4th September 1930

Temperature °C

Hour	*"Calorex"*	*Ordinary*
9.30 a.m.	22	24
10 a.m.	24	27
11 a.m.	26	29
12 noon	28	35
1 p.m.	28	38
2 p.m.	26	30
3 p.m.	28	32
4 p.m.	25	27
5 p.m.	25	29

Undernoted are detailed for comparison the number of insects found at the baits under "Calorex" and ordinary glass respectively.

Bright, Sunny Weather

Number of Insects

Hour	*"Calorex"*	*Ordinary*
9.30 a.m.	28	40
10 a.m.	31	52
11 a.m.	21	70
12 noon	20	53
1 p.m.	38	52
2 p.m.	21	54
3 p.m.	11	48
4 p.m.	16	37
5 p.m.	19	23

12th September 1930 Temperature °C.			Dull, Misty Weather Number of Insects		
Hour	*"Calorex"*	*Ordinary*	*Hour*	*"Calorex"*	*Ordinary*
10 a.m.	17	17	10 a.m.	9	11
11 a.m.	17	17	11 a.m.	8	12
12 noon	17	17	12 noon	0	3
1 p.m.	17	18	1 p.m.	3	5
2 p.m.	17	17	2 p.m.	11	16
3 p.m.	17	17	3 p.m.	11	13
4 p.m.	17	17	4 p.m.	10	13
5 p.m.	16	17	5 p.m.	9	13

From these tables it will be seen that the most important effect of the "Calorex" glass is the regulation of temperature, an effect which is most marked or even only marked in sunny weather.

It is noticeable that on the 4th Sept., 1930, at 1 p.m., when the temperature under ordinary glass reached 38deg. C., the number of insects under the "Calorex" glass increased, but at the other temperatures there was a markedly lower number of insects attracted by the baits under "Calorex" than under the ordinary glass. Because of the difficulty in counting actively moving insects, the figures in these experiments are only approximate, but they are sufficiently close to reality to represent the facts that the effect of "Calorex" in deterring flies and other insects from visiting baits is largely governed by temperature. Thus the disparity in the numbers of insects under the two kinds of glass rises as the temperature rises, and falls as it falls during the day.

The insects attracted to these baits were in order of abundance as follows:— Wasps (*Vespa vulgaris*). Flies—1. *Calliphora erythrocephala* (Bluebottle). 2. *Lucilla* species (Greenbottle). 3. *Protocalliphora*. 4. *Sarcophaga*. 5. *Anthomyidæ* (undetermined). Bees—Honey Bee (*Apis mellifica*).

It is of special interest to note that towards mid-day the effect of the "Calorex" glass was most marked, that is when the difference in temperature between the two glasses was increasing.

On the other hand that temperature is not the only factor acting was clearly shown in experiments in which bees enclosed in a glass cylinder were used. Thus by interchanging the glasses over the cylinder an immediate reaction was obtained, the bees moving at once from the "Calorex" shaded end of the cylinder to the end covered by clear glass.

In the bait experiments so marked a reaction was not apparent, and this is to be ascribed to the attraction of the bait itself. That is to say that the attraction of the bait was stronger than the deterrent action of the "Calorex" glass.

Further support in favour of the deterrent effect of "Calorex" glass is found in experiments carried out in the fly-house at the Imperial College.

In these experiments balloon traps were baited with mashed bread and banana and exposed in the fly-house which contained large numbers of house flies (*Musca domestica*), and of vinegar flies (*Drosophila*).

Counts of the flies in these traps made at intervals during the day between the hours of 10 a.m. to 4 p.m. showed that the traps under ordinary glass trapped a slightly higher number, of the order of 50 to 30 flies, than the "Calorex" glass, but that counts made on traps untouched throughout the day and overnight showed a markedly deterrent effect on the part of the "Calorex" as follows:—

	"Calorex"	*Ordinary*
House Fly	83	152
House Fly	87	268
Drosophila	30	150

In general, the experiments show that "Calorex" glass acts in two main ways, first, by shutting out heat rays, and second, by affecting the light rays. The first effect of heat exclusion is the more evident effect, and tends to mask the second and less evident effect of the light.

Both these effects give to "Calorex" glass a definite value as a fly deterrent which would probably be more evident in experiments on a larger scale.

The experiments suggest that the claims made for "Calorex" glass as a fly deterrent have a substantial basis in fact.

SOME TESTIMONIALS

TO "CALOREX" GLASS

(The originals of all the letters quoted below are in our possession, and may be inspected at our works by anybody who is interested.)

We thank you for your letter in regard to the "Calorex" heat-excluding anti-fly glass that you fitted into our model abattoir at Letchworth. It has been found extremely successful in preventing flies; we found that no fly could live in the hall, and any that entered were always found dead on the floor.

When some years ago representatives of Swift's of Chicago visited the abattoir, they were very much impressed by this fact.

H. Terrier, Secretary,
The Animal Defence and Anti-Vivisection Society

With reference to the "Calorex" heat-excluding glass which I specified and used in the abattoir for Messrs. Rowlands, I am pleased to say the result has been highly satisfactory in every way. In fact, I have again used it in another small private abattoir which I completed about twelve months ago. Both the abattoirs were designed and built on model lines, and "Calorex" has fully justified its use. It effectively checks the sun heat, and enormously reduces the presence of flies.

My clients are very pleased with the result, and several visitors to the buildings have been to me for particulars of the glass.

C. W. Miller, L.R.I.B.A., Stafford

We have now had a reasonable opportunity of gaining some experience of the heat-resisting properties of the "Calorex" green tinted glass which was fitted to the roof lights of our new premises in 1927.

The roof faces south-east, and therefore has the sun throughout the hottest part of the day; but we find the "Calorex" tinted glass which is fitted to this side has very definite heat-resisting properties and our staff are able to work in the building without fatigue during the summer.

Ralph E. Sanders & Sons, Ltd., Hitchin

The "Calorex" glass used largely throughout the Machado Tobacco Factory has been fully successful in reducing the heat and glare, and the company has been able to dispense with awnings which required constant renewal.

C. R. Howorth, A.N.Z.I.A., Kingston, Jamaica

With reference to your enquiry regarding the glass which you put in the roof of my garage about two years ago, I am pleased to state that it has been a complete success. Even on the warmest day of summer, with the sun beating on the glass, the temperature inside is quite cool.

———————, *Biggar*

The "Calorex" glass supplied by you to the Chad Fish Restaurant, New Street, has given every satisfaction.

On hot days, when the sun is shining on the full length of the verandah, the air is cool and pleasant. Flies no longer trouble us. Previous to the fixing of "Calorex" glass flies were a pest.

E. H. Trow, West Bromwich

At the end of last year we supplied the Burma Railways with about 130 square feet of "Calorex" Sheet Glass 21-oz. to be installed in one of the windows in their Drawing Office. On following this matter up, we are glad to say the Railway Company are extremely pleased with the results obtained and we anticipate receiving an order from them for a further 500 square feet.

William Jacks & Co., Ltd., Rangoon

You recently supplied some of this glass for the Junta de Caridad and this has been placed in the windows of one of the wards. Formerly this ward was the one most disliked by the doctors, but since "Calorex" has been installed the doctors have changed their opinion, and all want to use this ward. The President of the Junta is pleased with the resultant coolness, and later on other wards will be treated in a similar manner. The President of the Education Department has also seen the effect in the ward, and is very much in favour of using this glass for the schools.

Subsequent Letter

The name of the Hospital in which "Calorex" has been used is the San Juan de Dios Hospital, situated in San José. The ward in question was unbearably hot before "Calorex" was fitted, as the windows catch the full heat of the sun from 11.0 a.m. to about 4.0 p.m. I am glad to say that all the doctors now want their special cases to be put into this ward and all of them highly praise the coolness of the ward as well as the soothing effect of the green light admitted.

(Our Agent) San José, Costa Rica

We have found the "Calorex" glass very satisfactory during the present hot weather, and the warehouse in which it is installed certainly keeps remarkably cool. There do not appear to be any drawbacks connected with it, and we are well satisfied.

H. G. Kingham & Co., Dorking

Mr. Bismillah glazed the main building of a Japanese day school here with "Calorex" and has just had a call from the Headmaster, who states that it is a great success. He volunteered the information that since he had the building glazed with this he had hardly had a child asking to be allowed to go home complaining of head-ache. Because of the noise from the streets, school windows have to be kept closed, and the Headmaster says this glass is the cure. He has some annexes and says that as he gets the money in his hands he will do those also.

Late John Robertson & Co., Singapore

THE FOLLOWING LIST OF JOBS IN WHICH "CALOREX" HAS BEEN USED, BOTH IN GREAT BRITAIN AND OVERSEAS, GIVES SOME IDEA OF THE VARIETY OF SITUATIONS IN WHICH IT HAS BEEN FOUND TO BE VALUABLE AND DESIRABLE

Ceylon Government Railway Workshops	RATMALANA
Kodak Company's Offices	KINGSWAY, LONDON
Abattoir at Kirkcaldy	SCOTLAND
San Juan de Dios Hospital	COSTA RICA
New Grandstand, Ceylon Turf Club	COLOMBO
Electric Power Station	SINGAPORE
First National Bank	LOS ANGELES
Racquets Court, Wylam	NORTHUMBERLAND
Cochin Hospital	COCHIN
Post Office Sorting Room	DAGENHAM
Drawing Offices (Burma Railways)	RANGOON
Japanese Day School	SINGAPORE
Municipal Abattoir	ROTHERHAM
Barnet Glass Rubber Co.	SYDNEY
University Library	MADRAS
Trichinopoly Hospital	TRICHINOPOLY
Municipal Electric Power Station	SINGAPORE
Abattoir at Dundee	SCOTLAND
Law College Hostel	MADRAS
Sanders Garage	HITCHIN
South African Railways Machine Shop	JOHANNESBURG
Springfield Mental Hospital	WANDSWORTH
Shell Company's Building	NAIROBI
Post Office Sorting Room	THORNTON HEATH
Trichinopoly Combined Court	TRICHINOPOLY
Laboratory to Government	GUINDY
Kingham's Stores	DORKING
Government Printing Offices	SINGAPORE
Mechanical Transport Workshops	KHARTOUM
Drawing Office in Municipal Buildings	EDINBURGH
Calicut Hospital	CALICUT
Abattoir	STAFFORD
The Arrowroot Pool	ST. VINCENT, B.W.I.
Racquets Courts	MERCHANT TAYLORS' SCHOOL
Tuticorin Hospital	TUTICORIN
Mechanical Transport Workshops	ATBARA, SUDAN
Shell Company's Building	PORT SUDAN
The Southern Hotel	SINGAPORE
Model Abattoir	LETCHWORTH
Civil Hospital	KHARTOUM
United Dairies Ltd., Depot	BASON BRIDGE, SOMERSET
Palghat Victoria College Library	PALGHAT
South African Timber Co., Ltd.	BULAWAYO
New Printing Office	COLOMBO

Battery Rooms in various G.P.O. Telephone Exchanges

Printed by Simson and Co. Ltd., London and Hertford